University of Washington

Center for Experimental Nuclear Physics and Astrophysics (CENPA)

CENPA

The University of Washington Nuclear Physics Laboratory (NPL) has changed markedly over the years. Originally, our research was based primarily on our local accelerators. In the past decade this effort has expanded into SNO, RHIC, and other large collaborative experiments, as well as into smaller non-accelerator experiments. We have created CENPA in order to strengthen our capabilities in physics at the boundary between Nuclear Physics and other sub-disciplines. We have an excellent technical infrastructure with which to develop state-of-the-art equipment for pursuing this physics. We plan to have CENPA maintain this technical infrastructure, which originated with the NPL. Further, CENPA is positioned to encourage collaboration among the original NPL scientists and others in the UW Physics Department, as well as others in the wider community.

Present major research initiatives

Our largest effort is the SNO experiment. We have responsibility for data acquisition, and we are building the neutral current detectors (NCDs). SNO is taking data now with pure D_2O, and we are completing construction of the NCDs. NCD installation is scheduled for February 2002. The NCDs will give a definitive real time determination of the ratio of neutral current events to charged current events induced by solar neutrinos.

We are a significant part of the emiT experiment, which is a time reversal test in polarized neutron beta decay. We are responsible for the proton detectors and the electronics. This experiment ran at NIST in 1997, and obtained a lower the limit on the D coefficient in neutron beta decay that is below 2×10^{-3}. The proton detectors and electronics have been upgraded and a second run is planned later in 2001.

An experiment to improve our knowledge of the astrophysical S-factor for the $^{7}Be(p,\gamma)$ reaction is running on our tandem Van de Graaff accelerator. This experiment uses a new technique in which the beam is rastered over a small spot target. We have made significant modifications to the tandem to enable us to run beams of high intensity at energies down to 250 keV. Further modifications are planned to enable us to run at even lower energy.

Our research in relativistic heavy ion reactions is based on the STAR detector at RHIC, where we are involved in the event-by-event data analysis and in the Hanbury-Brown Twiss interferometry analysis.

At the University of Washington we have a group using torsion balances to search for new forces. One of the most recent of these experiments is searching for violations of the $1/r^2$ nature of gravity at distances below a millimeter. Some versions of string theory suggest an extra dimension that extends to the millimeter scale, and would cause gravity to deviate from the $1/r^2$ behavior below a millimeter. These experiments have achieved sensitivity at distances of 200 μmeters. Others of these experiments have established the best limits on the equivalence principle.

Using our accelerator and accelerators elsewhere, we are pursuing questions about the standard model of the electro-weak interaction. These measurements include second class current searches in the mass-8 system, studies of the details of the spectra in mass-8 beta decay, and searches for scalar weak interactions, done at ISOLDE with ^{32}Ar. In the case of the experiments done at other accelerators, substantial development work must often be done at our home facility before running at the remote facility.

Near term projects

At present and for the near term, we will be concentrating on completing and installing the SNO NCDs and making the measurement of the neutral current to charged current ratio. We will extend the ^{7}Be(p,γ) measurements to energies well below 300 keV.

Long term projects

We plan to have a major participation in the next generation neutrino experiment. While SNO is operating, the plans for this research will be laid and the research will be started. New initiatives in double and single beta decay and in solar neutrinos are under way. We will continue with RHIC and have a program of new experiments in nuclear astrophysics with the tandem.

A new faculty member at the UW is a member of CENPA and is doing experiments using atomic physics to study fundamental interactions. He is initiating an experiment to measure the electric dipole moment of ^{199}Xe, which is of significance to an understanding of CP violation.

People

There are 6 state supported faculty members whose research is either 100%, or in two cases 50%, supported through CENPA. There are 4 senior Research faculty, and two junior (term appointment) Research faculty. Typically 5 postdocs and 12 to 15 graduate students are supported by CENPA, and in addition a few graduate students are doing independent research while being supported by the University or by fellowships. A number of undergraduates are doing independent work or are hourly employees, assisting the research effort.

Professional technical staff consist of nine scientists or engineers who are crucial to design and construction of experimental equipment. Their skills include mechanical and electrical engineering; one of them is the computer systems manager; another two are physicists who participate in experiment operation and design; and all of them provide a major hands-on contribution to our research effort. In addition to the professional staff, there are three instrument makers (2.5 FTE) and an electronics technician. These people are highly skilled and professional in their own right, but are not included in the group classified as "professional staff" by the State of Washington. This entire staff provides the technical support that, for example, has enabled us to play an important role in SNO. They have made possible the construction and deployment of the NCDs and also are building the complex surface-mount electronics boards for the NCD data taking system.

Budgets

We have received an operating budget of $3.46M for each of FY1996 through FY2000. During this period we have been involved in significant construction of experimental equipment, and the University of Washington exempts costs for equipment construction from overhead. This exemption extends to manpower costs for academic people (students, postdocs, research faculty, and summer salaries). Nevertheless, because the fixed funding rate does not cover increasing costs, we have cut our program significantly during those five years. For FY2001 we received a 3% increment in operating funds. This increase, however, is not sufficient to cover either the increase in our overhead or inflation.

Our FY2001 funding level is not sufficient for us to maintain our level of effort. A major part of this effort is presently shifting from building to running SNO. But it is important that we maintain our technical infrastructure and get started on the next major experiment, while, at the same time, continuing to provide technical support to SNO and to other experiments.

One of our important missions is training students and postdocs. Recently we have found, as have our peer institutions, that it is difficult to attract postdocs of the quality we could get in the past. One reason is salary pressure. Universities are not able to pay anything like the salaries paid by national labs or by industry, but we need to increase our salary somewhat to make our postdoc positions more attractive. Students are also getting more expensive, partly because of tuition increases and partly because of salary inflation. The idea of increasing productivity is a popular one: Manufacture more using fewer people for lower total cost in spite of their increased wages. This concept does not apply to the support of students and postdocs in training.

Our major missions are education and research. Experimental research consists of a construction phase and a data-taking phase. The University of Washington charges overhead on the latter, in contrast to when we were in the equipment-building phase. At the same time we need to develop the ideas and experimental concepts that will produce the next experiment. This kind of research and planning is also not equipment construction and is subject to normal overhead.

At a constant-dollar budget with experiments successfully constructed, we can only curtail our effort, erode our infrastructure, graduate fewer students, train fewer postdocs, do fewer experiments and do them more slowly.